(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 072 188 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
31.01.2001 Bulletin 2001/05

(51) Int Cl.[7]: **A01K 63/06**

(21) Application number: **00401862.8**

(22) Date of filing: **29.06.2000**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **29.06.1999 US 340734**

(71) Applicant: **Elam-Electroluminescent Industries Ltd.**
Jerusalem 91450 (IL)

(72) Inventors:
- **Baumberg, Israel**
  Maale Adumim 98500 (IL)
- **Berezin, Oleg**
  Maale Adumim 98500 (IL)
- **Dvir, Joseph**
  Mevasseret Zion 90805 (IL)
- **Gorelik, Boris**
  Beit-Shemesh 99000 (IL)
- **Kachanovsky, Alex**
  Maaleh Adumim 98500 (IL)
- **Prager, Marc**
  Jerusalem 96750 (IL)
- **Voskoboinik, Moshe**
  Maale Adumim 98500 (IL)

(74) Representative: **Desaix, Anne et al**
Ernest Gutmann - Yves Plasseraud S.A.
3, rue Chauveau-Lagarde
75008 Paris (FR)

(54) Aquarium lighting system

(57) An illumination system (4; 104; 204) for illuminating an underwater space (2) is presented. The system comprises an elongated flexible electroluminescent light source (6; 106; 206) located substantially inside the underwater space and a power supply unit (8) located outside the underwater space. The power supply unit is connected to one end (6A) of the electroluminescent light source. At least this one end of the light source, which is connected to the power supply unit, is located outside the underwater space. The light source has at least one light-emitting element (14) located inside an inner insulating sheath (16), and has an outer insulating sheath (18). The inner insulating sheath and the outer insulating sheath are separated by a continuous air gap (20) coupled to an air region (24) outside the underwater space. This prevents the light source from being affected by water, and thereby from the reduction of its lifetime

EP 1 072 188 A1

Description

FIELD OF THE INVENTION

[0001] This invention is generally in the field of decorative illumination, and relates to an underwater illumination system, which is particularly useful for aquarium illumination.

BACKGROUND OF THE INVENTION

[0002] The decorative illumination of aquariums has been widely used, often employing simple heating lamps or fluorescent lamps accommodated above water. These techniques are disclosed, for example, in U. S Patents Nos. 3,908,598; 4,516,529; and 5,353,746. However, it was found that the bright illumination produced by these lamps could cause damage to some kinds of aquarium fish, affect their natural colors, and may cause the discoloration of various colored elements in the aquarium.

[0003] There is a great variety of systems utilizing standard lamps for underwater illumination. Unfortunately, these systems are bulky, owing to the unavoidable requirement for a suitable means to prevent the penetration of water into the regions of electrical contacts. This makes such systems unsuitable for decorative illumination.

[0004] Illumination systems based on LEDs have been developed, being disclosed, for example, in U.S. Patent Nos. 5,211,469 and 5,848,837. Notwithstanding the fact that these systems are more miniature than those based on the standard lamps, they suffer from the point-like nature and non-isotropic illumination of LEDs. Additionally, the use of LEDs requires electrical contacts to be located under water which, in turn, requires the provision of a special means for preventing water from penetrating the contact region.

[0005] Systems for decorative illumination of aquariums utilizing optical fibers as light sources have been developed, and are disclosed, for example, in U.S. Patents Nos. 3,749,901; 3,609,343; 5,067,059 and 5,546,289. These systems suffer from the drawback associated with the need for a bulky assembly aimed at inputting light into the optical fibers. Such an assembly typically comprises an external light source (i.e., lamp), a drive for rotating spectral filters, etc. Additionally, optical fibers are not sufficiently flexible, and provide the entire radiation output at the butt of the fibers only, that actually make them point-like light sources.

SUMMARY OF THE INVENTION

[0006] There is accordingly a need in the art to facilitate aquarium decorative illumination by providing a novel method and system for decorative underwater illumination.

[0007] The main idea of the present invention is based on the use of flexible, elongated light sources of a desired length, such as electroluminescent strips or filaments. Due to their high flexibility, such light sources can be desirably patterned within the under water space and coupled to a power source located outside this space.

[0008] It has been found by the inventors that in order to prevent a decrease in the lifetime of these light sources, the average relative moisture of the surrounding medium should be maintained at a level less than 70%. To this end, an emitting element of the light source is coated by inner and outer insulating sheaths, which define a continuous air gap therebetween. The air gap freely communicates with an air medium surrounding the underwater space. The air circulation through this gap will carry away the molecules of water that might have passed through the outer insulating sheath, and bring them outside the air gap. thereby preventing an increase in the average relative moisture in the vicinity of the inner insulating sheath.

[0009] There is thus provided according to one aspect of the present invention, an illumination system for illuminating an underwater space, the system comprising a light source accommodated substantially inside said underwater space, and a power supply unit accommodated outside said underwater space and connected to the light source, the system being characterized by that:

- said light source is an elongated flexible electroluminescent light source, which has at least one light-emitting element located inside an inner insulating sheath, and has an outer insulating sheath, wherein the inner insulating sheath and said outer insulating sheath are separated by a continuous air gap coupled to an air region outside the underwater space;
- said power supply unit is connected to one end of the electroluminescent light source, wherein at least said one end of the light source is located outside said underwater space.

[0010] The at least one light emitting element may be in the form of a substantially flat strip having at least one light-emitting surface, or in the form of a filament emitting light in all directions.

[0011] An opposite end of the light source may be located either inside or outside the underwater space. The end of the light source located inside the underwater space is hermetically sealed from the penetration of water into the air gap. If the opposite end of the light source is located outside the underwater space, this end of the light source is opened for connecting the air gap with the air region outside the space. A compressor may be provided outside the underwater space for intensifying air circulation within the gap.

[0012] The electroluminescent light source may comprise more than one light-emitting element, and may therefore be either single or multi-colored, which significantly amplifies the effect of decorative illumination. Each of the light-emitting elements has its own inner in-

sulating sheath, while the outer insulating sheath of the light source is common for all the light-emitting elements.

[0013] The outer insulating sheath may be integral with the at least one light emitting element, in which case the light source is non-detachable. The outer insulating sheath may be in the form of a substantially flexible substantially transparent tube having a cross-section such as to be mounted on and removed from an inner side of the light source. In this case, the light source is detachable.

[0014] Preferably, the system also comprises a moisture absorber accommodated inside the outer insulating tube.

[0015] More specifically, the present invention is used for decorative illumination of aquariums, and is therefore described below with respect to this application.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] In order to understand the invention and to see how it may be carried out in practices a preferred embodiment will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

Fig. 1 is a schematic illustration of an aquarium equipped with an illumination system constructed according to one embodiment of the invention;

Fig. 2 schematically illustrates one example of a light source suitable for use in the illumination system of Fig. 1;

Fig. 3a and 3b schematically illustrate two more examples of the light source suitable for use in the illumination system of Fig. 1;

Fig. 4 illustrates another example of the light source of the illumination system of Fig. 1 comprising a moisture absorber;

Fig. 5 illustrates yet another example of the light source having several light-emitting elements;

Fig. 6 is a schematic illustration of an aquarium equipped with an illumination system constructed according to another embodiment of the invention; and

Fig. 7 is a schematic illustration of an aquarium equipped with an illumination system according to yet another embodiment of the invention.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

[0017] Referring to Fig. 1, there is illustrated an aquarium **1** partly filled with water defining an underwater space **2**, and an illumination system, generally designated **4**. The system **4** includes an elongated flexible electroluminescent light source **6** whose one end **6A** is coupled to an AC power supply unit **8** through an electric wire **10**. As shown, the end **6A** of the light source **6** is located outside the aquarium **1**, above the water level **2A**. while an opposite end **6B** of the light source **6** is located inside the underwater space **2**. A tip **12** hermetically seals the end **6B** from the water penetration therein.

[0018] The electroluminescent light source **6** operates in the following manner. It has at least one light-emitting element, which typically includes an inner wire electrode coated by dielectric and electroluminescent layers, and an outer electrode in the form of a transparent conducting layer. The supply of alternating voltage with a frequency of about 50-4000Hz and an amplitude about 50-250VRMS to electrodes of the light emitting element, causes the emission of light of a certain color (i.e., frequency range), depending on the kinds of electroluminophore and filters used in the light source. The main principles of implementing an electroluminescent light source having one or more light-emitting elements are known *per se,* being described for example in U.S. Patents Nos. 5,485,355 and 5,869,930, assigned to the assignee of the present application.

[0019] It is generally known that an electroluminescent light source is highly susceptible to damage and malfunction caused by exposure to moisture. This feature hardens its use for applications requiring the accommodation of the light source under water. When surrounding the electroluminescent light source by a transparent flexible insulating layer, the water steam, whilst diffusing therethrough, penetrates into the inner electroluminescent layer, which significantly decreases the lifetime of the light source.

[0020] It has been found by the inventors, that the substantial decrease of the lifetime of a light source of the kind specified above occurs within several days when the average relative moisture of the surrounding medium is more than 80%. When the average relative moisture is between 70% and 80%, the changes in its lifetime are negligible, and are not observed at all when the average relative moisture is less than 70%. Hence, to prevent an undesirable decrease in the lifetime of the light source. the average relative moisture of a surrounding medium should be maintained at a level less than 70%. This is implemented in the following manner.

[0021] Fig. 2 is a longitudinal section view of the light source **6** constructed according to one possible example of the invention suitable to be used in the illumination system **4**. In this specific example, the light source **6** includes a single elongated flexible light-emitting element **14** which is coated by inner and outer insulating sheaths **16** and **18** spaced-apart from each other by a spacer **20**. The inner insulating sheath **16** is made of a flexible transparent polymer material, such as polyethilene, having the thickness of 0.3-0.5mm. The outer insulating sheath **18** is made of a flexible transparent polymer having the thickness of 0.5-1mm. The spacer **20** is a polymer thread in the form of a cylindrical spiral having the diameter of 0.4-2mm, which encloses the inner sheath **16**. The inner and outer insulating sheaths **16** and **18**

define a continuous air gap **22** therebetween, whose width is approximately equal to the diameter of the spacer **20**. This air gap **22** freely communicates with air medium **24**, surrounding the underwater space **2** (i.e., the aquarium 1).

[0022] It is understood that the air circulation through this air gap **22** would result in that the molecules of water, that might have passed through the outer insulating sheath **18**, will be carried away by the circulated air flow and will be brought outside the air gap **22**. As a result, the average relative moisture in the air gap **22** in the vicinity of the inner insulating sheath **16** becomes close to that of the air at home in which the aquarium **1** is located. The average relative moisture at home is practically less than 70%.

[0023] Turning now to Figs. 3 a and 3b, the spacer **20** separating the inner and outer insulating sheaths **16** and **18** is in the form of a strip having a triangular cross-section. The height of the spacer **20** is approximately 1mm. The spacer **20** is integrally made with either of the insulating sheaths **16** or **18**, thereby making the light source **6** detachable and non-detachable, respectively.

[0024] In the example of Fig. 3a, the spacer **20** is integrally made with the outer sheath **18** being formed directly on the surface of the inner sheath **16**. In this case the light source **6** is non-detachable.

[0025] According to the example of Fig. 3b, the spacer **20** is integrally made with the inner sheath **16**, and the outer sheath **18** is designed like a flexible transparent polymer tube having the wall thickness about 0.5-1mm. The inner sheath **16**, together with the spacer **20**, is installed inside this tube **18**. Consequently, in this case, the light source **6** is detachable.

[0026] Fig. 4 exemplifies an electroluminescent light source **106** having a somewhat different construction as compared to the previously described examples. The same reference numbers are used for identifying those components which are identical in the elements **6** and **106**. In the light source **106**, capsules **26** containing a moisture absorber, for example alumogel, are provided, being accommodated within the air gap **22** in a spaced-apart relationship along the gap. The outer insulating sheath **18** is in the form of a flexible transparent tube. By removing this tube, the capsules **26** could be replaced by new ones, which may be performed once in several months.

[0027] Fig. 5 illustrates yet another example of a light source **206** suitable to be used in the illumination system **4**. Similarly, to facilitate understanding, those components which are common in the constructions of Figs. 2, 4 and 5 are identified by the same reference numbers. The light source **206** includes a plurality of light-emitting elements - three in the present example, **14A**. **14B** and **14C**. The light-emitting elements have electroluminophors and different spectral filters proving their luminescence with blue, yellow and red colors, respectively. Each of the emitting elements **14A**, **14B** and **14C** has its own inner insulating sheath designated **16A**, **16B** and **16C**, respectively. All the emitting elements **14A-14C** together with their inner insulating sheaths **16A-16C** are mounted inside the outer insulating sheath **18** of the entire light source **206**. The continuous air gap **22** is formed within a space between the inner sheaths **16A-16C** and the outer sheath **18**.

[0028] It should be noted although not specifically shown, that the power supply unit **8** may comprise a plurality of programmable connection ports for connecting thereto the emitting elements. This allows for maximizing the decorative illumination effect. Additionally, the illumination system may comprise a sensor means that shifts the system from its operative position to its inoperative position, upon detecting that ambient light reaches a predetermined value.

[0029] Reference is now made to Fig. 6, illustrating the aquarium **1** equipped with an illumination system **104** constructed according to another embodiment of the invention. The same reference numbers are used for identifying common components in the systems **4** and **104**. Here, in distinction to the system **4**, both ends **6A** and **6B** of the electroluminescent light source **6** are located outside the aquarium **1**, i.e., above the water level **2A**. The end **6A** is coupled to the AC power supply unit **8** through the electric wire **10**. As for the opposite end **6B**, the air gap (not shown here) at this end is coupled to a compressor **28** through a tube **29**. Periodical actuation of the compressor **28** provides relatively strong air circulation through the air gap, as compared to that in the absence of the compressor **28**, which significantly reduces the possibility of the moisture penetration towards the inside of the light-emitting element of the light source **6**. It should be understood, although not specifically shown, that the light source may comprise one or more light-emitting element, being constructed as described above with reference to either of Figs. 2, 3a, 3b, 4 or 5.

[0030] Fig. 7 illustrates an aquarium **1** equipped with an illumination system **204** having a somewhat different construction as compared to the systems **4** and **104**. The illumination system **204** is associated with an oxygen enrichment system **30** of the aquarium **1**. To this end, the compressor **28** serves for supplying air to a porous tip **32** through the transparent tube **29**. Air, in the form of small balls **34** (bubbles), penetrates into the underwater space **2** through the tip **32**. The electroluminescent light source **6** is located inside the tube **29**. The end **6A** of the light source **6** located inside the tube **29** is hermetically sealed by the tip **12**, while the opposite end **6B** is taken away from the tube **29** so as to be outside the aquarium **1**. The electrodes (not shown) of the light source **6** at the end **6B** are electrically connected to the power supply unit **8** though the wire **10**.

[0031] The advantages of the present invention are thus self-evident. The illumination system has a simple construction, and is relatively light in weight as compared to those based on the use of standard lamps and optical fibers. Due to the provision of the continuous air

gap between the inner and outer insulating sheaths of the electroluminescent light source, which air gap freely communicates with an air medium surrounding the underwater space, the invented system provides safety means for preventing the light source from being affected by water, and thereby from the reduction of its lifetime.

[0032] Those skilled in the art will readily appreciate that various modifications and changes may be applied to the preferred embodiments of the invention, as hereinbefore exemplified without departing from its scope defined in and by the appended claims. For example, the power supply unit may be of any known kind, the use of the AC power supply enhancing the brightness of illumination. The light source may comprise one or more light-emitting elements.

Claims

1. An illumination system (4; 104; 204) for illuminating an underwater space (2), the system comprising a light source (6; 106; 206) accommodated substantially inside said underwater space, and a power supply unit (8) accommodated outside said underwater space and connected to the light source, the system being characterized by that:

   - said light source is an elongated flexible electroluminescent light source, which has at least one light-emitting element (14) located inside an inner insulating sheath (16), and has an outer insulating sheath (18), wherein the inner insulating sheath and said outer insulating sheath are separated by a continuous air gap (22) coupled to an air region (24) outside the underwater space;
   - said power supply unit is connected to one end (6A) of the electroluminescent light source, wherein at least said one end of the light source is located outside said underwater space.

2. The system according to Claim 1, wherein the underwater space is located inside an aquarium (1).

3. The system according to Claim 1, wherein said at least one light-emitting element is a substantially flat strip having at least one light-emitting surface.

4. The system according to Claim 1, wherein said at least one light-emitting element is a filament emitting radiation in all directions.

5. The system according to Claim 1, wherein an opposite end (6B) of said at least one light source is located inside said underwater space.

6. The system according to Claim 5, wherein said opposite end is hermetically sealed from penetration of the water into the air gap.

7. The system according to Claim 1 and also comprising at least one additional light-emitting element (14A, 14B, 14C) each having a corresponding inner insulating sheath (16A, 16B, 16C).

8. The system according to Claim 7, wherein the light-emitting elements emit radiation of different spectral ranges.

9. The system according to Claim 7, wherein Said power supply unit has a plurality of connection ports each for connecting the light-emitting element thereto.

10. The system according to Claim 1, wherein said outer insulating sheath is integral with said at least one light-emitting element, the light source being non-detachable.

11. The system according to Claim 1, wherein said outer insulating sheath is a substantially flexible substantially transparent tube having a cross-section such as to be mounted on and removed from an inner side of the light source, the light source being detachable.

12. The system according to Claim 11, and also comprising a moisture absorber (26) accommodated inside said tube.

13. The system according to Claim 1, wherein an opposite end (6B) of said light source is located outside the underwater space, the ends of the light source being opened for connecting said air gap with the air region outside the space.

14. The system according to Claim 13, wherein said air gap is connected to a compressor (28) intensifying air circulation within the gap.

15. The system according to Claim 2, wherein said light source is accommodated inside a substantially transparent tube (29) through which air is supplied into the aquarium.

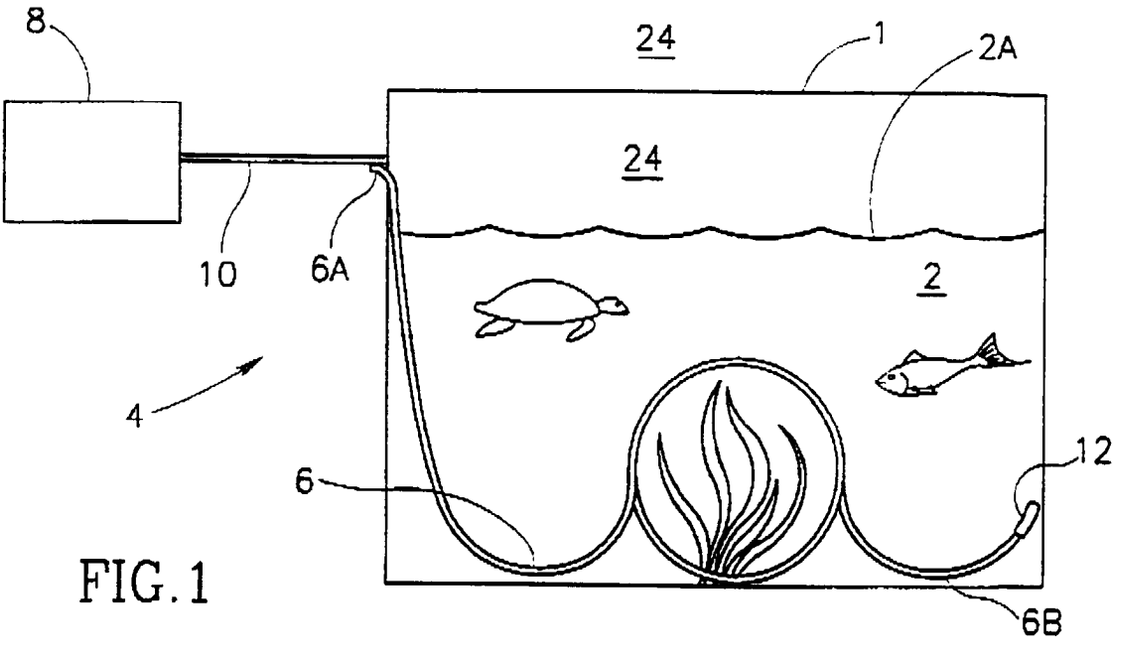

FIG.1

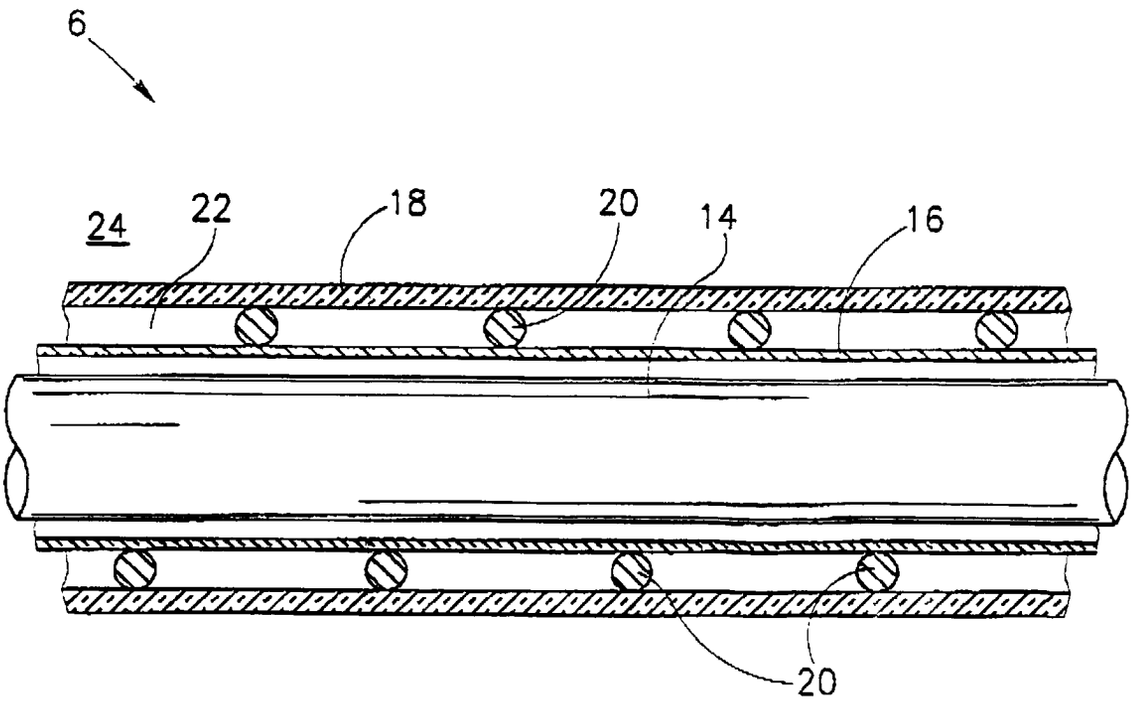

FIG.2

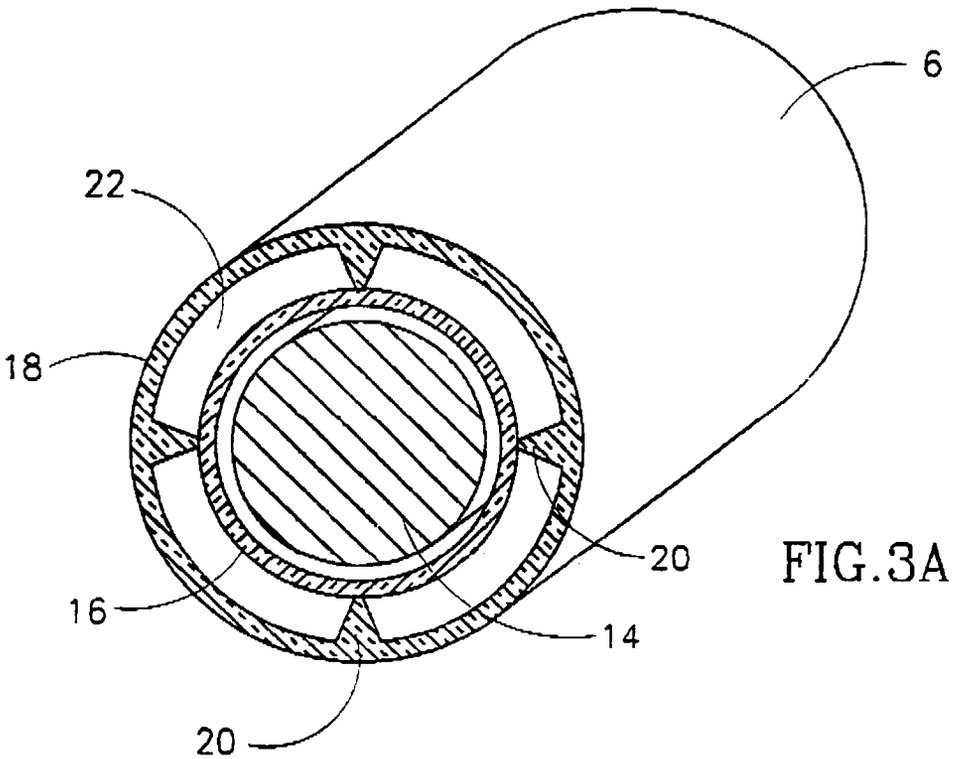

FIG.3A

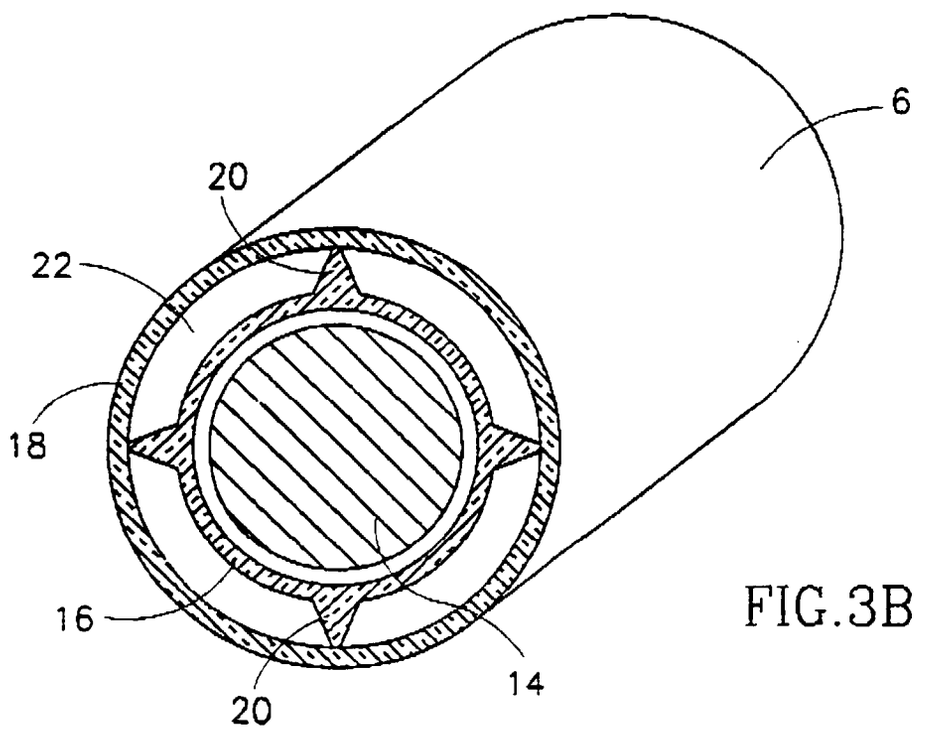

FIG.3B

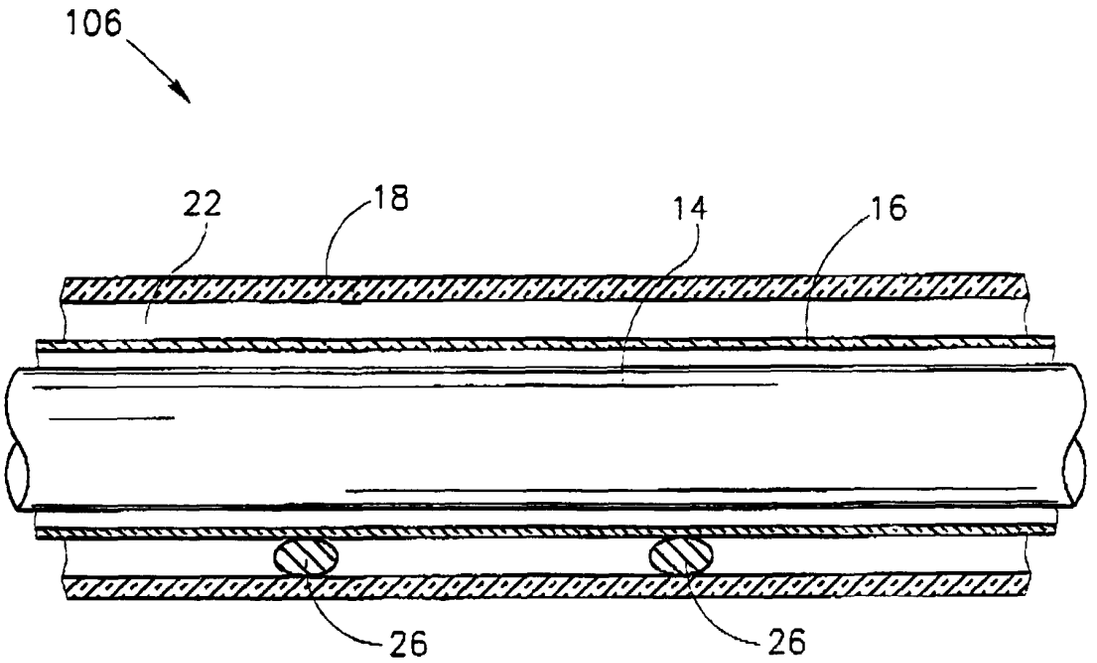

FIG.4

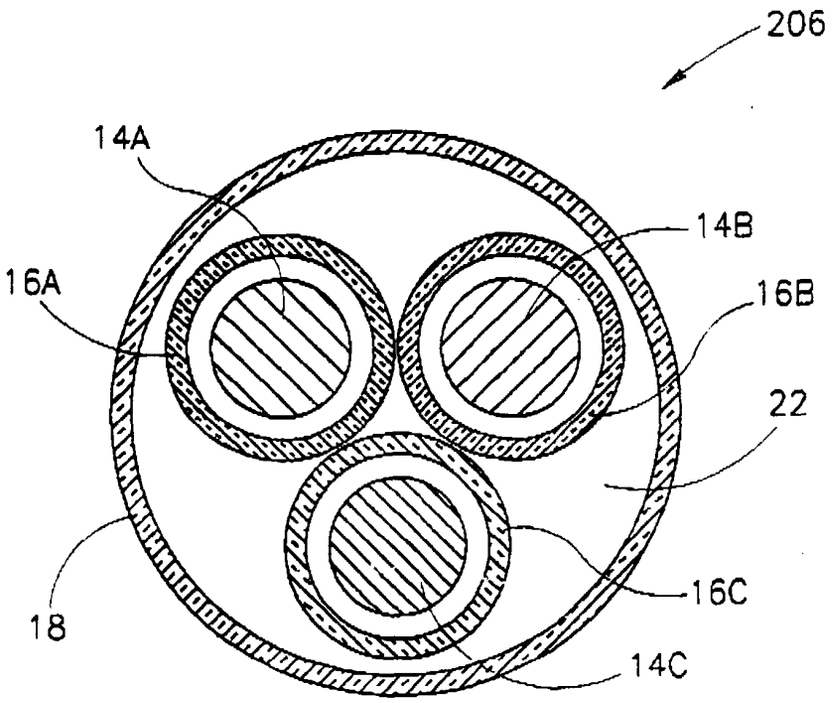

FIG.5

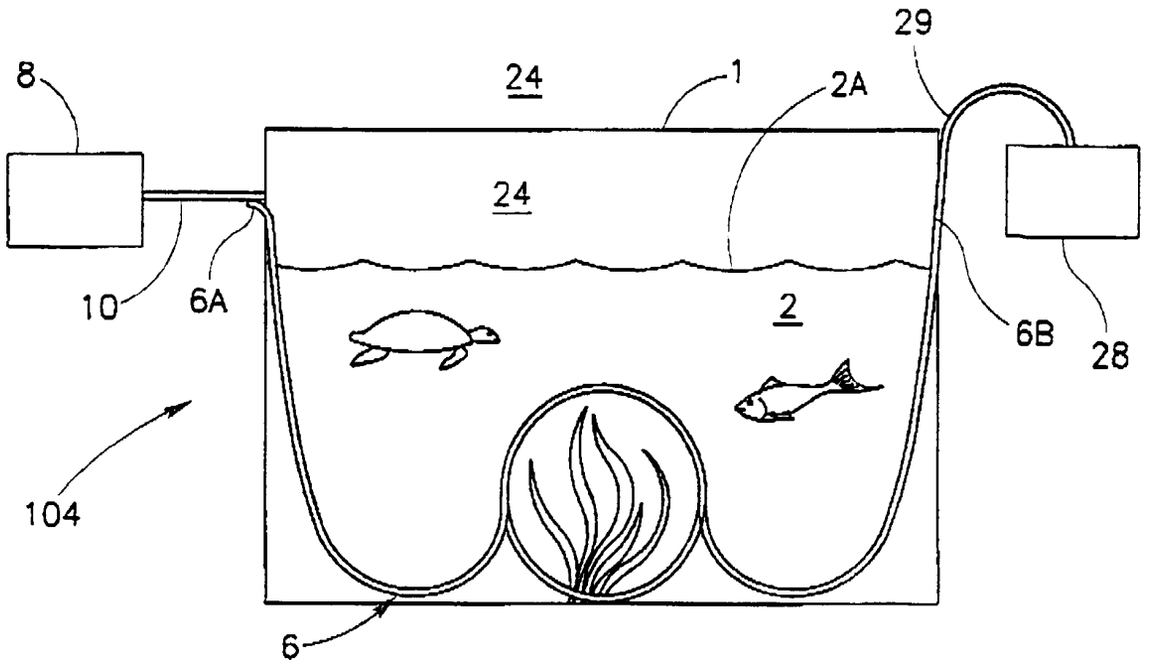

FIG.6

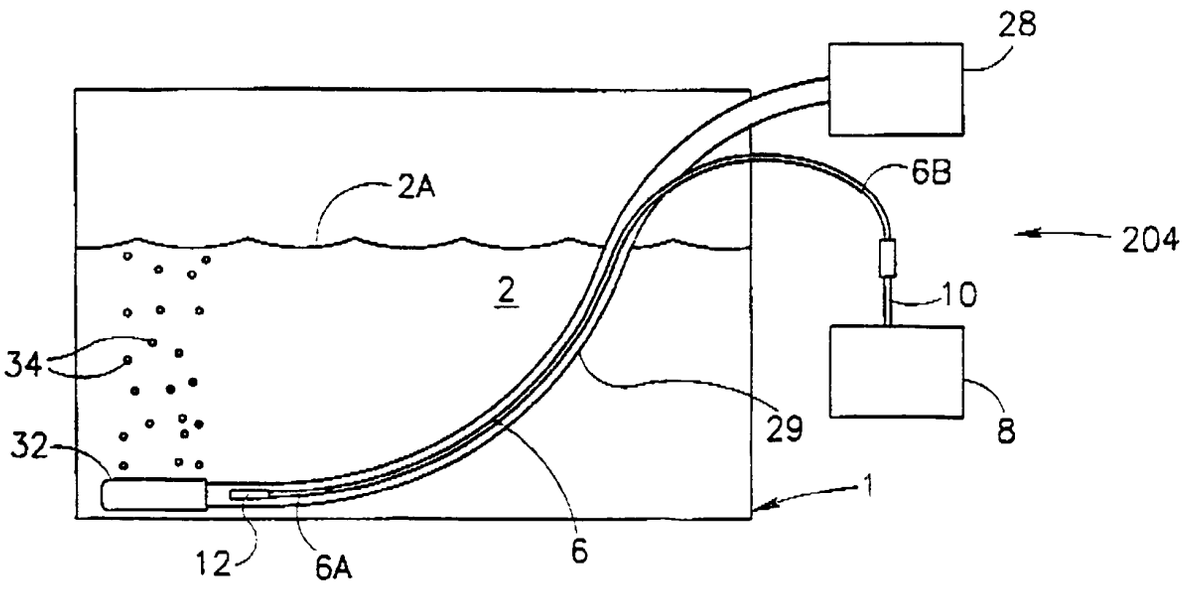

FIG.7

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 40 1862

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 5 211 469 A (SCHWALBE STUART A ET AL) 18 May 1993 (1993-05-18) * the whole document *	1-15	A01K63/06
A	US 3 749 901 A (CLOUGH D) 31 July 1973 (1973-07-31) * column 4, line 3-12; figures 1,3 *	1-15	
A	US 3 609 343 A (HOWLETT MARK K) 28 September 1971 (1971-09-28) * column 3, line 41-65; figures 1,4 *	1-15	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

A01K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	18 October 2000	Weber, G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 00 40 1862

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

18-10-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5211469 A	18-05-1993	US 5165778 A	24-11-1992
		CA 2068319 A	10-05-1991
		EP 0500812 A	02-09-1992
		JP 5504440 T	08-07-1993
		WO 9107641 A	30-05-1991
US 3749901 A	31-07-1973	DE 2109639 A	16-09-1971
US 3609343 A	28-09-1971	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82